Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

The court declared that there was no hard and fast rule requiring that the nature of a drug should be proved by chemical analysis and not otherwise. (Public Health Reports, Aug. 14, 1914, p. 2154.)

Another decision concerning habit-forming drugs was made by the Kentucky Court of Appeals, which held that in an indictment for violation of a statute which prohibits the sale of "opium or its alkaloidal salts or their derivatives" it is sufficient to charge that the defendant sold "morphine." According to the court, the Kentucky law of 1913 prohibiting the sale of opium or its alkaloidal salts or their derivatives for any purpose other than for "legitimate use" is sufficiently definite to be enforceable and valid. (Public Health Reports, Jan. 1, 1915, p. 53.)

Tuberculin Tests of Dairy Cows.

That the requirement that the cows used in dairy business, where milk is sold generally to the people, should be inspected as to their health twice during the year does not violate the constitution of Mississippi nor section 1 of the fourteenth amendment to the Federal Constitution was the view in a decision handed down by the Supreme Court of Mississippi during the year. The court also declared that the purpose of such a regulation was to prevent the spread of disease among human beings, and that therefore its promulgation and enforcement by the State board of health, rather than by the live-stock sanitary board, was proper. (Public Health Reports, Apr. 9, 1915, p. 1111.)

Ant Poison—Sale of.

The California act of 1913 relative to the sale of ant poison was construed by the California District Court of Appeals, Second District, as prohibiting the sale of ant poison containing arsenic except by registered pharmacists. In one section the act included ant poison among articles which could be sold by grocers and dealers generally without restriction, but in another section the sale of ant poison containing arsenic or certain other poisons was limited to licensed pharmacists. (Public Health Reports, June 18, 1915, p. 1851.)

ESSENTIALS OF SWIMMING-POOL SANITATION.[1]

By WALLACE A. MANHEIMER, Ph. D., Department of Bacteriology, Columbia University.

Swimming pools in the United States are growing enormously in number and popularity. Ninety-nine large municipalities (1) have established them, and the number is on the increase. The educational importance of swimming has been greatly emphasized, many colleges and secondary schools having as a graduation requirement ability to swim. Swimming pools have also been established in clubs, steamships, and private residences. That their proper care and sanitation are of the utmost importance, therefore, is apparent. Accordingly, in order to secure data concerning the different swimming pools under different conditions of management, 46 were examined, but in this paper it is necessary to consider the results obtained from the examination of only six of these, to demonstrate the importance of refiltration and chemical disinfection in the care of swimming pools that are open to the public.

---

[1] Read before the American Association to Promote Hygiene and Public Baths, City Hall, New York City, May 15, 1915.

Within recent years the sanitation of swimming pools has been much studied. Some authors have emphasized the danger of contracting diseases, while others have sought means to make them safe.

Diseases transmissible from swimming in polluted water are chiefly of a venereal, ocular, aural, or intestinal nature (Aitken No. 2). Hertzka (3) and Sticker (4) demonstrated experimentally that bacillus prodigiosus can pass into the vagina of a woman while swimming. Skutch (5) reported an epidemic of vulvovaginitis that spread to 236 girls in a swimming pool at Posen. Fehr (6) and Schultz (7) reported cases of conjunctivitis and Cobb (8) of inflammation of the ear from swimming in contaminated water. Jäger (9), Pfuhl (10), Shäfer (11), Lenhartz (12), Klein and Schütz (13), Dresher (14), Witte (15), Kirchner (16), Hartog (17), Bassin (18), Maier (19), Baginsky (20), and others have reported cases of typhoid fever and other intestinal diseases in persons who had swum either in pool or in sewage-polluted water.

Typhoid fever in New York City is endemic, and at times epidemic. Jackson's report to the Merchants Association of New York (21) showed that the tides are inadequate in removing the solid masses of feces, and that there accumulate along the shore when the tides fall large masses of human excreta, in summer covered with flies. The Metropolitan Sewage Commission (22) has clearly pointed out the danger of typhoid fever to the community, due to the large bodies of contaminated water that surround New York. Rosenau, Lumsden, and Kastle (23) estimated that three-tenths of 1 per cent of the general population were typhoid carriers. Park (24, p. 288) reported the case of "Typhoid Mary," who infected 26 persons, some fatally, with typhoid fever, and who has recently been responsible for many more cases. Bolduan and Noble (25) gave an instance of a dairyman who disseminated typhoid bacilli for 42 years. In view of these facts the danger of typhoid carriers getting into a pool is considerable, and therefore an accurate index of a pool's contamination with intestinal bacteria is very important.

The study of methods of the sanitation of swimming pools has been directed either to refiltration or to chemical disinfection: Kister and Fromme (26), Angel (27), and Crane (28) have examined refiltration systems and found that not only did the appearance and sanitary condition of the water improve but that there resulted a material reduction in the cost of maintenance. In the chemical disinfection of swimming pools certain of the methods used in the purification of drinking water have been of value; copper sulphate was used by Stokes (29), Burrage (30), Rettger and Markley (31), and several others; Alexander (32) found the electrolysis of magnesium chloride effective, but the use of calcium hypochlorite has now supplanted all other methods. Burrage (33), Bunker (34), Aitken (35), Whipple (36), Lewis (37), Rettger and Markley (38), Lyster (39), Tully (40), The Engineering Record (unsigned) (41), Manheimer (42), Ravenel (43), Markley (44), and Bunker and Whipple (45) all have recommended its use for the purpose of disinfection after thorough tests of its efficiency had been made.

In the following analysis it will be shown that a combination of the methods of refiltration and chemical disinfection is the best means to secure a sanitary condition of a swimming pool.

Technique of Bacterial Water Analysis.

Collection of samples.—A standard weighted bottle (Abbott) was used for bottom and mid-depth samples. For surface collections a bottle was held by a wire clamp, so that only water at the surface flowed in. The necks of all bottles, prior to sterilization, were wrapped in stiff brown paper, so that the lips and stoppers would be protected from dust. During cold weather samples that reached the laboratory 30 minutes after collection were not ice packed. All other samples were placed in a copper box of two compartments, an upper one with racks for bottles, and a lower one for sawdust and ice. The temperature of bottles so transported was about 6° C.

Quantitative Bacterial Analysis.

Samples were plated in standard meat infusion agar and gelatin. The agar plates were incubated at 37.5° C. and the gelatin at 20° C. Counts were made 24 and 36 hours after plating on agar, and 4 and 5 days after plating on gelatin. The growths on these respective media represent different sections of the bacterial flora of the pool water examined; many bacteria will grow on neither medium, whilst the more rapid growers at high temperatures on the agar approximately represent the pollution.

Dilutions from samples were so made that 1 c. c. could always be plated, this being done so as to have the error normal to reading pipettes always the same. Dilution tubes of 9 c. c. of salt solution were made in small quantities, kept on ice, and marked so that evaporation could be noticed. When plating, the sample or its dilution was added directly to the plate, the agar or gelatin being poured over. Several dilutions were made from each sample, and duplicate plates from each dilution. When any wide discrepancy occurred in counts of the same sample, the tests were discarded.

Qualitative Bacterial Analysis.

Qualitative analyses comprised attempts to isolate the typhoid bacillus and the colon bacillus. In the attempt to isolate the typhoid bacillus a special technique was devised and tested experimentally as follows: To 1½ liters of water inoculated with a known number of colon and typhoid bacilli was added 15 c. c. of pepton ox bile (without sugar). This mixture was placed in the incubator at 42.5° C.,[1] and left there undisturbed for 48 hours. Twenty c. c. were then drawn off the top and, following the method of Adami and Chapin, treated with enough inactivated typhoid immune serum to make a proportion of 1 of serum to 60 of water. The next day these tubes were centrifugalized and the precipitate washed in salt solution by several recentrifugalizations. A small part of the precipitate was then thoroughly emulsified in salt solution and plated in Hiss's medium. Suspicious colonies were fished, replated, and finally isolated on agar slants. The agglutinability of the bacilli so isolated was tested against a powerful serum. In nine determinations to discover the efficiency of this method it was found that when 50 to 75 typhoid bacilli in the presence of several thousand colon bacilli were added to 1½ liters of water the typhoid bacilli could be recovered, but that when less than that number were added the method was not always successful.

Ten pools were subjected to the above analysis, but no typhoid bacilli were found.

The presence of colon bacilli in water is usually attributed to sewage contamination. Though it might be supposed that the few colon bacilli present in a pool before use might grow to a noticeable extent, as a matter of fact no such growth was observed. In the pool examined, colon bacilli were not found in the water before use, the subsequent presence of these bacteria consequently is due to their addition by bathers. The tests for colon bacilli, before and after the pool's use, therefore give an approximate index of a pool's pollution with intestinal bacteria by bathers.

---

[1] In a study of the inhibition of elevated temperature to the growth of the colon-typhoid group, it was found that no marked inhibition occurred up to 43° C. With every additional degree above 37 C. more marked inhibition of the growth of water bacteria takes place. For this reason all colon-typhoid analyses were made at 42.5° C.

In the tests for the presence of colon bacilli Jackson's lactose bile medium (46) was prepared by adding 1 per cent lactose and 1 per cent pepton to pure undiluted ox bile. This medium was tubed in standard fermentation tubes and sterilized in the Arnold steam sterilizer for 15 minutes for three days.[1] Five tubes were used for all samples, including tap-water controls, as follows:

(1) To the first was added 1 c. c. of pool water.
(2) To the second was added 1 c. c. of pool water.
(3) To the third was added 1 c. c. of a tenth dilution of No. (2).
(4) To the fourth was added 1 c. c. of a tenth dilution of No. (3).
(5) To the fifth was added 1 c. c. of a tenth dilution of No. (4).

Thus each test was fully controlled.

Twenty per cent of gas in the closed arm of the fermentation tubes was considered positive for the presence of colon bacilli, after verifying tests had been made[2] (Jackson 46 and Manheimer 42).

Results of Bacterial Analysis.

The results obtained from the bacteriological examination of the following six pools were selected because they illustrate by comparison the superiority of refiltration and chemical disinfection to the ordinary methods of pool sanitation.

POOL NO. 1.

This pool is patronized by two classes of attendance. During the day it is used for teaching purposes in a high-school physical training course. In the evenings it is open to the male adult public without restriction or charge for its use. The daily attendance is about 400. The pool has a small capacity of 24,500 gallons, and uses unfiltered city water. Although this pool is quite shallow (5 feet at the deep end), its floor could not be seen. This was due to the large amount of suspended matter in unfiltered Croton water. This pool was examined in 1911 (A) when no chemical was added to the water and again in 1913 (B) when chloride of lime was employed as a disinfectant.

---

[1] Jackson recommends the autoclave for 15 minutes at 15 pounds pressure, but because of the possibility of hydrolizing the lactose, and because of the frequent wetting of the cotton plugs by this method, discontinuous sterilization was preferred.

[2] The efficiency of the presumptive test for colon bacilli was demonstrated by plating on agar from all positive fermentation tubes and by fishing and identifying the colonies from the plates. Colon bacilli are practically always present in analysis of swimming pool water when a positive presumptive colon test is obtained.

Table 1 A.

SAMPLES AT A TIME WHEN NO CHEMICAL WAS USED.

Collection data.				Results of quantitative analysis.		Results of qualitative analysis.			
				Bacteria in c. c.		Test for colon bacilli.			
Time of collection.	Water in use (hours).	Level collected from—	Total attendance.	Agar at 37° C.	Agar at 20° C	1.000	0.100	0.010	0.001
May 22, 1911, p. m.	12	Surface	400	2,400	31,600	+	+	−	−
Do	12	Middle	400	1,000	7,400	+	+	−	−
Do	12	Bottom	400	1,300	6,400	+	+	−	−
May 23, 1911, p. m.	36	Surface	800	16,800	57,240	+	+	+	−
Do	36	Middle	800	8,900	76,320	+	+	−	−
Do	36	Bottom	800	17,300	127,200	+	+	+	−
May 24, 1911, p. m.	60	Surface	1,200	7,300	25,440	+	+	−	−
Do	60	Middle	1,200	6,400	50,880	+	+	−	−
Do	60	Bottom	1,200	7,600	50,880	+	+	−	−

By reference to the above table, it will be seen that the number of bacteria in the water markedly increased after each day's use. The highest count was on the evening of the second day, when 127,200 bacteria in a cubic centimeter were obtained from an agar plate grown at 20° C. Colon bacilli were very numerous; 10 per c. c. or more being present in every sample.

Table 1 B.

Collection data.				Results of quantitative analysis.		Results of qualitative analysis.			
				Bacteria in c. c.		Test for colon bacilli.			
Time of collection.	Water in use (hours).	Level collected from.	Total attendance.	Agar at 37° C.	Gelatin at 20° C.	1.000	0.100	0.010	0.001
Tap sample on morning of first day				12	35	−	−	−	−
Apr. 7, a. m.	0	Surface	0	220	1,990	−	−	−	−
Apr. 7, p. m.	12	do	400	600	25,440	+	−	−	−
Do	12	Bottom	400	3,200	12,720	+	−	−	−
Apr. 8, a. m.	36	Surface[1]	400	130	740	−	−	−	−
Apr. 8, p. m.	48	do	800	500	4,452	+	−	−	−
Do	48	Bottom	800	7,800	165,360	+	−	−	−
Apr. 9, a. m.	60	Surface[1]	800	1,120	27,980	−	−	−	−
Apr. 9, p. m.	72	do	1,200	800	38,160	+	−	−	−
Do	72	Bottom	1,200	800	38,430	+	−	−	−

[1] Treatment with hypochlorite.

In the above table the effect of the addition of chloride of lime can readily be observed. In no sample was more than one colon bacillus per cubic centimeter obtained, and the bacterial counts were relatively much lower than in Table 1A. Had the addition of the chemical been properly controlled, less bacteria would have been present in the water.

This pool was unsanitary largely because of the small volume of water offered to so large an attendance. Its condition improved greatly as a result of disinfection with calcium hypochlorites, but the addition of the chemical was not properly controlled, and the pool was a menace to the health of the high-school boys. To make this plant safe it is necessary to increase its cubic capacity and install a refiltering plant.

POOL NO. 2.

This pool is open to the general public, without charge, accommodating on alternate days a very large attendance of men and women. It has a capacity exceeding 80,000 gallons, uses filtered city water, with alum as a coagulant. The cost of maintenance of this bath (47) is $29,798.49, exclusive of the cost of water, which would be approximately $450 a year.

This pool was examined (A) when refilled every day, (B) when refilled every second day, and (C) when refilled every third day. After one day's use of this pool the water became cloudy and the pool's floor was therefore obscured.

Table 2 A.

POOL EMPTIED EVERY DAY.

Collection data.				Results of quantitative analysis.		Results of qualitative analysis.			
				Bacteria in c. c.		Test for colon bacilli.			
Time of collection.	Water in use (hours).	Level collected from.	Total attendance.	Agar at 37° C.	Gelatin at 20° C.	1.000	0.100	0.010	0.001
Apr. 20, 1911	5	Surface	50	5,600	(1)	+	–	–	–
Do	5	Middle	50	1,600	(1)	+	–	–	–
Do	5	Bottom	50	2,700	(1)	+	+	–	–

(1) Not made.

Bacterial counts ranged from 1,600 to 5,600 per c. c. and colon bacilli were always present in 1 c. c. Only 50 women had used the pool; therefore, its polluted condition was undoubtedly due as much to insufficient cleansing before filling as to the débris added by the bathers. The cost of daily refilling is great, and judged by the above bacterial data not very efficient from a sanitary point of view.

Table 2 B.

POOL EMPTIED EVERY SECOND DAY.

Collection data.				Results of quantitative analysis.		Results of qualitative analysis.			
				Bacteria in c. c.		Test for colon bacilli.			
Time of collection.	Water in use (hours).	Level collected from—	Total attendance.	Agar at 37° C.	Gelatin at 20° C.	1.000	0.100	0.010	0.001
Tap sample on morning of first day				12	137	–	–	–	–
Same water passed through filter				3	68	–	–	–	–
Mar. 4, 1913, a. m.	3	Surface	10	260	3,180	–	–	–	–
Mar. 4, 1913, p. m.	12	do	202	1,700	20,500	+	–	–	–
Do	12	Middle	202	1,000	14,600	+	+	–	–
Do	12	Bottom	202	3,600	11,100	+	–	–	–
Mar. 5, 1913, a. m.	26	Surface	202	700	1,300	+	–	–	–
Mar. 5, 1913, p. m.	38	do	1,600	445,200	879,400	+	+	–	–
Do	38	Middle	1,600	655,800	636,000	+	–	–	–
Do	38	Bottom	1,600	162,200	667,700	+	–	–	–

SEPARATE SAMPLE AFTER ONE DAY'S USE BY MEN.

Mar. 3, 1913, p. m.	12	Surface	1,400	216,240	222,260	+	–	–	–

When the pool was refilled every other day, the rise in the number of bacteria was much greater than when refilled daily. Tap water gave a bacterial count of 137 per c. c. This water after being passed through the filter was cleared, and the bacterial count reduced to 68 per c. c. As soon as the pool was used the bacterial counts increased enormously; at the end of the first day the average count was 15,000 per c. c. and at the end of the second day, over 650,000 per c. c. Colon bacilli were present in every sample taken after the first day's use of the pool, and at times 10 colon bacilli per c. c. were obtained. This pool was in very insanitary condition, therefore, when practicing refillings every other day.

Table 2 C.

POOL EMPTIED EVERY THIRD DAY.

Collection data.				Results of quantitative analysis.		Results of qualitative analysis.			
				Bacteria in 1 c. c.		Test for colon bacilli.			
Time of collection.	Water in use (hours).	Level collected from.	Total attendance.	Agar at 37° C.	Gelatin at 20° C.	1.000	0.100	0.010	0.001
Mar. 16, 1911	5	Surface	0	300	450	–	–	–	–
Do	5	Middle	0	90	30	–	–	–	–
Do	5	Bottom	0	10	40	–	–	–	–
Mar. 22, 1911	60	Surface	1,000	12,380	20,600	+	+	+	–
Do	60	Middle	1,000	12,140	22,260	+	+	+	–
Do	60	Bottom	1,000	11,740	25,440	+	+	+	–

When the pool was refilled every third day, the condition became somewhat worse than in the case of either of the two previously discussed methods. Though the counts were no higher (see table), colon bacilli were more numerous, and at the end of the third day 100 colon bacilli per c. c. were found in all samples.

It is clear that this pool, even when refilling daily, was not in satisfactory condition, though plenty of water was used and no expense saved in management. The large and promiscuous attendance and lack of proper supervision mainly account for its polluted condition.

POOL NO. 3.

This pool empties once a week and practices refiltration. It has a capacity of 55,000 gallons and is situated on the top floor, advantage being taken of this elevated position to use the pool water for flushing closets, urinals, and traps throughout the building. About 145,000 gallons are drawn weekly from the pool, fresh water, of course, being added in its place. This is equivalent to two and one-half refillings per week. The cost of extra-heavy construction to sustain the weight of the pool on the top floor of the building and the cost of additional plumbing for separate flushing purposes are soon compensated for by the economy in water.

Table 3 A.

Collection data.				Results of quantitative analysis.		Results of qualitative analysis.			
				Bacteria in c. c.		Test for colon bacilli.			
Time of collection.	Water in use (hours).	Level collected from—	Total attendance.	Agar at 37° C.	Gelatin at 20° C.	1.000	0.100	0.010	0.001
Tap sample, morning of first day.	....	....	....	5	65	–	–	–	–
Same sample, through filter taken from pool.	....	....	....	40	190	–	–	–	–
Sample from filter before it reached pool.	....	....	....	43	42	–	–	–	–
Filtrate, obtained by reversing the filter.	....	....	....	10,000	61,000	+	+	+	–
Mar. 10, 1913, p. m.	12	Surface	250	200	89,040	–	–	–	–
Do	12	Middle	250	100	48,000	–	–	–	–
Do	12	Bottom	250	200	49,000	+	–	–	–
Mar. 12, 1913, a. m.	48	Surface	500	120	360	–	–	–	–
Mar. 12, 1913, p. m.	60	...do	700	1,500	4,800	–	–	–	–
Do	60	Middle	700	1,100	6,360	+	–	–	–
Do	60	Bottom	700	300	4,400	–	–	–	–
Mar. 14, 1913, a. m.	98	Surface	1,300	130	340	+	–	–	–
TESTS MADE IN 1911.									
					Agar, 20°				
May 3, 1911, p. m.	72	Surface	1,200	500	5,200	–	–	–	–
Do	72	Middle	1,200	500	1,000	–	–	–	–
Do	72	Bottom	1,200	600	4,000	–	–	–	–
June 2, 1911, p. m.	120	Surface	1,500	500	1,200	–	–	–	–
Do	120	Middle	1,500	600	1,200	–	–	–	–
Do	120	Bottom	1,500	30,000	2,400	–	–	–	–

The highest counts obtained from samples taken during the entire week was 6,360 bacteria per c. c. Colon bacilli were not uniformly found. The sanitary condition of this plant was exceedingly good. The addition of small quantities of chloride of lime to the water would undoubtedly have rendered this pool almost ideal.

POOL NO. 4.

Wealthy clubmen use this pool. It has a capacity exceeding 90,000 gallons, uses filtered city water, with no chemical treatment, refills every two weeks, and practices dilution, equivalent to another filling in the two weeks. Its average daily attendance is about 30. All the men using this pool have had, preliminary to swimming, either a Turkish or thorough soap bath.

Table 4 A.

Collection data.				Results of quantitative analysis.		Results of qualitative analysis.			
Time of collection.	Water in use (hours).	Level collected from—	Total attendance.	Bacteria in c. c.		Test for colon bacilli.			
				Agar at 37° C.	Gelatin at 20° C.	1.000	0.100	0.010	0.001
Filtered water, first day of use.[1]	......	......	......	5	254	—	—	—	—
Apr. 7, 1913, a. m.[2]	0	Surface	0	330,700	171,720	+	+	—	—
Apr. 14, 1913, a. m	168	do	180	150	350	—	—	—	—
Apr. 14, 1913, p. m	180	do	200	700	6,360	+	—	—	—
Do	180	Bottom	200	3,600	13,200	+	—	—	—
Apr. 22, 1913, a. m	360	Surface	450	200	6,360	—	—	—	—
Apr. 22, 1913, p. m	372	do	480	100	1,400	—	—	—	—
Do	372	Bottom	480	300	700	—	—	—	—
Apr. 23, 1913, a. m	384	Surface	480	180	230	—	—	—	—
Apr. 23, 1913, p. m	396	do	500	300	2,100	—	—	—	—
Do	396	Bottom	500	400	4,400	—	—	—	—
Apr. 24, 1913, a. m	408	Surface	500	180	3,800	+	—	—	—
Apr. 24, 1913, p. m	420	do	530	600	3,800	+	—	—	—
Do	420	Bottom	530	300	1,300	+	—	—	—

[1] Tap (unfiltered) water, not available.

[2] Only 1,000 gallons in pool; high count due to small volume and to insufficient cleansing of floor of pool.

The table above indicates the excellent condition of the water. The highest count obtained was 13,200 bacteria per c. c. from a sample collected after the pool had been used a little more than a week. Colon bacilli were found in 1 c. c. of the pool water only in a few of the samples. In addition to this good sanitary condition of the water, the floor could be seen during the entire two weeks.

When it is considered that 180,000 gallons of water are offered for a total of 530 baths, and, furthermore, that the preliminary baths of members were very thorough, one is little surprised to find so excellent a condition. The cost of maintenance of this bath, however, is excessive.

POOL NO. 5.

This pool has a capacity of 100,000 gallons, uses filtered city water, with no chemical treatment. It has a large attendance of college men, aggregating 2,000 a week. A constant stream of fresh water is kept running through, about 450,000 gallons of water being used each week. This pool was examined under three different conditions: (A) when filled twice a week; (B) when new filters were installed, and the pool filled once a week; and finally (C) when filtered, diluted, etc., the same as in "B," but at a time when temporarily not used for bathing.

Table 5 A.

Collection data.				Results of quantitative analysis.		Results of qualitative analysis.			
Time of collection.	Water in use (hours).	Level collected from—	Total attendance.	Bacteria in c. c.		Test for colon bacilli.			
				Agar at 37° C.	Gelatin at 20° C.	1.000	0.100	0.010	0.001
Apr. 10, 1911, a. m.	12	Surface	0	190	440	–	–	–	–
Do	12	Middle	0	100	440	–	–	–	–
Do	12	Bottom	0	70	530	–	–	–	–
Apr. 10, 1911, p. m.	19	Surface	400	2,100	3,000	–	–	–	–
Do	19	Middle	400	900	1,800	–	–	–	–
Do	19	Bottom	400	500	2,100	+	–	–	–
Apr. 11, 1911, p. m.	33	Surface	700	3,300	21,700	+	+	–	–
Do	33	Middle	700	2,400	4,900	+	–	–	–
Do	33	Bottom	700	2,700	6,900	+	–	–	–
Apr. 12, 1911, p. m.	57	Surface	1,200	1,100	2,300	–	–	–	–
Do	57	Middle	1,200	600	1,700	–	–	–	–
Do	57	Bottom	1,200	2,200	3,000	–	–	–	–

Table 5 B.

Collection data.				Results of quantitative analysis.		Results of qualitative analysis.			
Time of collection.	Water in use (hours).	Level collected from—	Total attendance.	Bacteria in c. c.		Test for colon bacilli.			
				Agar at 37° C.	Gelatin at 20° C.	1.000	0.100	0.010	0.001
Feb. 17, 1913, p. m.	9	Surface	400	500	Not made.	–	–	–	–
Do	9	Middle	400	300	...do...	–	–	–	–
Do	9	Bottom	400	100	...do...	–	–	–	–
Feb. 18, 1913, p. m.	33	Surface	800	300	...do...	+	–	–	–
Do	33	Middle	800	900	...do...	–	–	–	–
Do	33	Bottom	800	1,400	...do...	+	–	–	–
Feb. 19, 1913, p. m.	57	Surface	1,200	5,800	...do...	–	–	–	–
Do	57	Middle	1,200	2,000	...do...	+	–	–	–
Do	57	Bottom	1,200	1,800	...do...	–	–	–	–
Feb. 20, 1913, p. m.	81	Surface	1,600	17,000	...do...	–	–	–	–
Do	81	Middle	1,600	16,500	...do...	–	–	–	–
Do	81	Bottom	1,600	14,000	...do...	+	–	–	–
Feb. 21, 1913, p. m.	105	Surface	2,000	200	...do...	–	–	–	–
Do	105	Middle	2,000	400	...do...	–	–	–	–
Do	105	Bottom	2,000	500	...do...	–	–	–	–

Table 5 C.

TEST OF MORNING SAMPLES AT A TIME WHEN THE POOL WAS NOT ATTENDED. THE EFFECT OF DILUTION IS HERE PLAIN.

Collection data.				Results of quantitative analysis.		Results of qualitative analysis.			
Time of collection.	Water in use (hours).	Level collected from—	Total attendance.	Bacteria in c. c.		Test for colon bacilli.			
				Agar at 37° C.	Gelatin at 20° C.	1.000	0.100	0.010	0.001
A. M.									
Tap water on morning of first day.	....	....	....	13	192	—	—	—	—
Same water through filter (taken from pool).	....	....	....	0	3	—	—	—	—
May 13, 1913..............	24	Surface........	0	20	10	—	—	—	—
May 14, 1913..............	48	.....do........	0	2	35	—	—	—	—
May 15, 1913..............	72	.....do........	0	160	280	—	—	—	—

By examining the tables it will be seen that the sanitary condition of the water was always satisfactory. Low counts were usually obtained, and colon bacilli, though present, were never abundant. In Table 5C the only varying factor from the pool's usual procedure was that it was not used for swimming during the entire week. The water was somewhat superior from a bacteriological point of view to the drinking water from the tap, but the filters were unable to clarify it.

The filters were worked far beyond their capacity. They should have been operated much more slowly, cleaned more frequently, and the water from the pool recirculated through them. In this way the water would have been freed from suspended matter, and the danger from drowning, which actually occurred, much diminished. The addition of chlorine, properly controlled, might have been effective in keeping down the bacterial content, and so perfected this otherwise excellently managed bath.

POOL NO. 6.

This pool has a capacity of 250,000 gallons, and uses filtered city water, with alum as a coagulant. The student body, all college men, as in the previous case, are well instructed in pool sanitation and the plant in general is well supervised. The pool was examined at three different times, once when refilling every third week, again when chloride of lime was used in addition to the refilling every third week, and finally, when a new filter was installed, refiltration and chlorination practiced and the water retained for months.

Table 6 A.

NO CHEMICAL USED.

Collection data.				Results of quantitative analysis.		Results of qualitative analysis.			
Time of collection.	Water in use (days).	Level collected from—	Total attendance.	Bacteria in c. c.		Test for colon bacilli.			
				Agar at 37° C.	Gelatin at 20° C.	1.000	0.100	0.010	0.001
May 3, 1911	17	Surface	3,000	72,200	190,800	+	—	—	—
Do	17	Middle	3,000	160,000	139,900	+	—	—	—
Do	17	Bottom	3,000	41,600	171,700	+	—	—	—
May 5, 1911	19	Surface	3,400	31,000	109,000	+	—	—	—
Do	19	Middle	3,400	36,000	79,000	+	—	—	—
Do	19	Bottom	3,400	40,000	50,000	+	—	—	—

When the above data were collected no sanitary precautions were observed, other than the addition of dilution water sufficient to approximate a weekly filling. The filters were worked beyond their capacity to clarify the water, therefore the pool's floor could not be seen. The bacterial counts were as high as 160,000 per c. c. Colon bacilli were present in 1 c. c. of every sample.

Table 6 B.

CHEMICAL USED.

Collection data.				Results of quantitative analysis.		Results of qualitative analysis.			
Time of collection.	Water in use (days).	Level collected from—	Total attendance.	Bacteria in c. c.		Test for colon bacilli.			
				Agar at 37° C.	Gelatin at 20° C.	1.000	0.100	0.010	0.001
May 8, 1911	4	Surface	800	300	900	—	—	—	—
Do	4	Middle	800	300	1,000	—	—	—	—
Do	4	Bottom	800	100	3,200	—	—	—	—
CHEMICAL ADDED NIGHT BEFORE.									
May 10, 1911	6	Surface	1,000	0	0	—	—	—	—
Do	6	Middle	1,000	0	300	—	—	—	—
Do	6	Bottom	1,000	0	0	—	—	—	—
May 26, 1911	22	Surface	3,000	0	100	—	—	—	—
Do	22	Middle	3,000	0	200	—	—	—	—
Do	22	Bottom	3,000	0	100	—	—	—	—
NO CHEMICAL ADDED THE NIGHT BEFORE.									
May 27, 1911	23	Surface	3,000	300	2,100	—	—	—	—
Do	23	Middle	3,000	500	1,400	—	—	—	—
Do	23	Bottom	3,000	2,000	3,000	—	—	—	—

Here the technique of management was varied only in one particular, i. e., chloride of lime was added to the water, in an amount to make a proportion of one of chloride to one million of water. The bacterial counts rarely were higher than those of drinking water, while many of the samples were entirely sterile. The efficiency of this procedure was thereby demonstrated.

Table 6 C.

Collection data.				Results of quantitative analysis.		Results of qualitative analysis.			
				Bacteria in c. c.		Test for colon bacilli.			
Time of collection.	Water in use (time).	Level collected from—	Total attendance.	Agar at 37° C.	Gelatin at 20° C.	1.000	0.100	0.010	0.001
Sample from tap, morning of first day				20	60	—	—	—	—
ANHYDROUS CHLORINE USED.									
May 12, 1913, a. m.	1 week	Surface	1,800	5	540	—	—	—	—
May 12, 1913, p. m.	7½ days	do.	2,100	10	860	—	—	—	—
Do.	do.	Bottom	2,100	70	450	—	—	—	—
May 13, 1913, a. m.	9 days.	Surface	2,100	50	290	—	—	—	—
May 13, 1913, p. m.	9½ days	do.	2,400	60	620	—	—	—	—
Do.	do.	Bottom	2,400	30	520	—	—	—	—
May 14, 1913, a. m.	10 days	Surface	2,400	70	420	—	—	—	—
Sample from refilter				5	410	—	—	—	—
TESTS MADE WHEN CALCIUM HYPOCHLORITE WAS USED.									
February 17, 1913, p. m.	7 days.	Surface	2,100	100	Not made	—	—	—	—
Do.	do.	Middle	2,100	2,800	do.	—	—	—	—
Do.	do.	Bottom	2,100	800	do.	—	—	—	—
February 21, 1913, p. m.	11 days	Surface	3,300	1,500	do.	—	—	—	—
Do.	do.	Middle	3,300	2,300	do.	—	—	—	—
Do.	do.	Bottom	3,300	2,400	do.	—	—	—	—

The cloudy condition of the water, which makes the danger of accidental drowning great, caused the director in charge to have a new filtering plant installed. Refiltration was then practiced, and the water thereby rendered exceedingly clear. Chloride of lime and anhydrous chlorine (Buswell No. 48) were added to the water in carefully controlled amounts. When the hypochlorite was used no colon bacilli were found. The highest bacterial counts obtained were 2,800 and 2,300 per c. c. When anhydrous chlorine was used the counts were somewhat lower, averaging about 500 bacteria per c. c., colon bacilli never being found in 1 c. c. The improved appearance and sanitary condition of the water are sufficient reasons for making this procedure standard.

Conclusions.

1. The cubic capacity of a pool affects its sanitary condition. Pool No. 1, of small capacity, was never in a satisfactory condition, even when disinfecting with calcium hypochlorite, while Pool No. 4,

using no chemical purifier, and depending entirely upon the use of a large body of water for a relatively small attendance, was in excellent condition.

2. The process of adding dilution water is an efficient means of reducing the bacterial content of the water of a pool, as evidenced in pools Nos. 3 and 5. In these two pools, accommodating large attendances, the water was kept bacterially pure mainly through that means.

3. The supervision of the plant and the class of attendance are also important factors in pool sanitation. The sanitary condition of pool No. 5 as compared with that of pool No. 2 illustrates this point admirably. Though both of these pools have the same general technique of management, the sanitary condition of pool No. 5 is far superior to that of pool No. 2, largely because of the careful supervision of the plant on the part of the director and the superior practice of hygiene on the part of college men as compared with that of the general public.

4. Refiltration is an adequate means of clarifying the water, thereby making it possible to see a submerged person. In pools Nos. 3 and 6 the water was rendered very clear by this method. In all the other pools where refiltration was not practiced, the water became so clouded after one day's use that the pool's floor could not be seen, thus increasing the danger of accidental drowning.

5. Chemical disinfection with calcium hypochlorite is effective, as evidenced from pool No. 6. If added infrequently, however, or in too small a quantity, as in pool No. 1, its value is largely lost. When employing this chemical, therefore, the quantity dissolved in the water should be measured from time to time by any simple device, such as that suggested by Woodhead (49), and a trace of chlorine kept constantly present.

6. The combination of refiltration and chlorination as practiced in pool No. 6 rendered the sanitary condition of the water excellent, besides keeping it continuously clear and reducing the cost of operation. It is believed, therefore, that the most important mode of keeping a pool in a safe and sanitary condition is by the combined method of refiltration and chlorination for the respective purposes of clarification and disinfection.

The writer wishes to express thanks to Dr. Hans Zinsser and to Dr. Augustus B. Wadsworth for the material help rendered during the course of the work.

Bibliography.

1. Bulletin of the Bureau of Labor, Sept., 1904, pp. 1245–1367.
2. Aitken: Proc. Ill. Water Supply Assoc., 1911, 3, p. 73.
3. Hertzka: Monatschr. f. Geburtsh. u. Gynäk., 1902, 16, p. 3.
4. Sticker: Zeitschr. f. Geburtsh. u. Gynäk., 1901, 45, p. 510.

5. Skutch: Centralbl. f. Bakteriol, 1892, 12, p. 309.
6. Fehr: Berl. Klin. Wchnschr., 1900, 1, p. 37.
7. Schultz: Ibid, 1899, 39, p. 36.
8. Cobb: Boston Med. and Surg. Jour., 1908, 159, p. 9.
9. Jäger: Zeitschr. f.-Hyg. u. Infectionkrankh., 1892, 12, p. 525.
10. Pfuhl: Deutsche Mil. Wchnschr., 1888, 17, p. 9.
11. Shäfer: Ibid, 1890, 36, p. 39.
12. Lenhartz: München Med. Wchnschr., 1892, 6, p. 898.
13. Klein and Schütz: Wien. Med. Wchnschr., 1898, 6, p. 238.
14. Dresher: Sanitätsber. u. d. Kgl. Preuss. Armee, 1898.
15. Witte: Ibid, 1898.
16. Kirchner: Deutsche Mil. Wchnschr., 1888, 17, p. 95.
17. Hartog: Sanitätsber. u. d. Kgl. Preuss. Armee., 1897.
18. Bassin: Ibid, 1896.
19. Maier: Proc. Roy. Med. and Chir. Soc. London, 1908, 2, p. 227.
20. Baginsky: Hyg. Rundschau, 1896, 6, p. 597.
21. Jackson: Pollution of New York Bay, Merchants' Assoc. of N. Y., 1909.
22. Rept. Met. Sewage Com., New York City, 1908–1910.
23. Rosenau Lumsden and Kastle: Bull. 52, U. S. P. H. S., 1909.
24. Park: Pathogenic Bacteria and Protozoa.
25. Bolduan and Noble: Jour. Am. Med. Assoc., 1912, 58, p. 7.
26. Kister and Fromme: Gsndhts Ingenieur, 1910, 30, p. 30.
27. Angel: Assoc. Mun. and County, Eng., 1908, 34, p. 960.
28. Crane: Eng. List, 1912, 21, pp. 11–43, and Proc. Am. Assoc. Promote Hyg. and Pub. baths, 1913.
29. Stokes: Am. Med., 1905, 10, p. 1075.
30. Burrage: Proc. Ind. As. of Sc., 1909.
31. Rettger and Markley, Eng. News, 1911, 66, p. 699.
32. Alexander: Scient. Am. Supp., 1909, 68, p. 1765.
33. Burrage: Proc. Ind. As. of Sc., 1909.
34. Bunker: Am. Jour. Pub. Health, 1910, 20.
35. Aitken: Proc. Ill. Water Supp. Assoc., 1911, 3, p. 73.
36. Whipple: Mun. Jour. and Eng., 1911, 31, p. 577.
37. Lewis: Eng. News, 1911, 65, p. 636.
38. Rettger and Markley: Eng. News, 1911, 66, p. 699.
39. Lyster: Jour. Am. Med. Assoc., 1911, 57, p. 1992.
40. Tully: Am. Jour. Pub. Health, 1912, 11, p. 1186.
41. Eng. Record, 1912, 65, p. 699.
42. Manheimer: Am. Phy. Ed. Rev., 1912, 17, p. 669, and Jour. Inf. Dis., 15, no. 1, p. 159.
43. Ravenel: Am. Phy. Ed. Rev., 1912, 17, p. 684.
44. Markley: Ibid, Feb., 1913.
45. Bunker and Whipple: Ibid, p. 75.
46. Jour. Inf. Dis., 1910, 7, p. 587; ibid, 1909, 6, 289; ibid, 1911, 8, p. 289; Jour. Ind. and Eng. Chem., 1909, 1, p. 328; Jour. Inf. Dis., 1907, Supp. 3, p. 300; ibid, 1911, 8, p. 241.
47. Rept. of the President of the Borough of Manhattan, N. Y. City, 1912.
48. Buswell: Am. Phy. Ed. Rev., 1913, 17, p. 395.
49. Woodhead: Jour. Roy. San. Inst., Sept., 1910, p. 281.